Map MODERNIZATION

Federal Emergency Management Agency

FEMA's Flood Hazard Mapping Program

Guidelines and Specifications *for* Flood Hazard Mapping Partners

Appendix J: Specifications and Format for Flood Insurance Study Reports

FEDERAL EMERGENCY MANAGEMENT AGENCY

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Appendix J

Format and Specifications for Flood Insurance Study Reports

The Federal Emergency Management Agency (FEMA) has established a concise, standardized format for the presentation of the facts, figures, and results of a Flood Map Project.—the Flood Insurance Study (FIS) report. This Appendix includes guidance for the Mapping Partner that performed the detailed hydrologic and/or hydraulic analyses to follow in preparing and submitting content to be included in the FIS report. This Appendix also includes detailed FIS report preparation guidance for the Mapping Partner that reviews and processes the draft materials and prepares the Preliminary and Final versions of the FIS report, including submittal of the report to the FEMA Map Service Center (MSC). A sample, completed FIS report for a single community is included in Section J.4 for guidance.

J.1 Submittal Content for Flood Insurance Study Reports

The Mapping Partner that performed the detailed hydrologic and/or hydrologic analyses for the Flood Map Project (hereinafter referred to as the submitting Mapping Partner) shall submit only the information outlined below. Unless specifically requested to do so by the FEMA Lead for the Flood Map Project (usually, the Regional Project Officer of the Project Officer at FEMA Headquarters), the submitting Mapping Partner shall not draft a complete FIS report. The information submitted will be used by the Mapping Partner that reviews the draft materials provided by the submitting Mapping Partner and prepares the Preliminary and Final versions of the FIS report (hereinafter referred to as the processing Mapping Partner).

If FEMA published an effective FIS report for the community, the submitting Mapping Partner will not need to submit certain information. The submitting Mapping Partner is to limit the submitted information for each section to information pertinent to the current Flood Map Project and to those events that have occurred since the date of the effective FIS report (e.g. new population information, major flood event).

The processing Mapping Partner shall include the new information in the Preliminary and Final versions of the FIS report as discussed in Subsection J.2. The requirements to be followed by the submitting Mapping Partner are summarized in Subsections J.1.1 through J.1.7.

J.1.1 Section 1.0, Introduction

For Subsection 1.1, Purpose of Study, the following information is to be included:

- Community name;
- County name; and
- State name.

For Section 1.2, Authority and Acknowledgments, the following information is to be included:

- Name(s) of Mapping Partner(s) that performed flood hazard analyses for Flood Map Project;
- Interagency Agreement Number or Contract Number;
- Completion date (month and year);
- Name and address of base map provider/agency; and
- Base map compilation source, scale, and date; coordinate system; projection; datum; any modifications to the base map source; and any restrictions on the release of base map data.

For Subsection 1.3, Coordination, the following information is to be included:

- Initial Consultation and Coordination Officer (CCO) meeting date;
- Attendees and agencies represented at the initial CCO meeting;
- Intermediate CCO meeting data and attendees (if applicable); and
- Contacts made for purposes of acquiring information.

J.1.2 Section 2.0, Area Studied

For Subsection 2.1, Scope of Study, the following information is to be included:

- Areas excluded from the study, as well as areas of extraterritorial jurisdiction;
- Names of flooding sources studied using detailed methods (listed in the same order as they appear in the Flood Profiles);

- Limits of detailed study for flooding sources studied partially using approximate methods;
- Names of Flooding sources studied by approximate methods; and
- Flooding sources on which the study was terminated, where the 1-percent-annual-chance floodplain permanently narrowed to less than 200 feet wide or for which the detailed study was ended where the drainage area was less than 1 square mile, when applicable.

For Subsection 2.2, Community Description, the following information is to be included:

- General description of the community's location within the county and state;
- Surrounding communities and their locations with respect to the subject community;
- Other nearby large cities and their locations relative to the community; and
- A brief description of the community.

The brief description may include population and census reference; patterns of residential and commercial development; the extent and nature of floodplain development; natural features that affect flood hazards in the community; and sufficient description of climatic, physiographic, and land use factors to support the discussion of flood problems that follows in Subsection 2.3.

For Subsection 2.3, Principal Flood Problems, the following information is to be included:

- Discharges and recurrence intervals of major floods;
- Locations (city and state) of all stream gages for studied streams;
- Any factors that aggravate flood problems; and
- Photographs of flooding, flood-control structures, and other flood-related subjects (with location of photograph noted).

For Subsection 2.4, Flood Protection Measures, the following information is to be included:

- A description of all flood protection structures and floodplain management measures used to reduce potential flood damage;
- A description of all dams, including those affecting the community that lie outside the community;
- A description of dams within the community used for purposes other than flood control; and

- A description of levees and whether they meet the Federal Emergency Management Agency (FEMA) 3-foot freeboard requirement and any other provisions of Section 65.10 of the National Flood Insurance Program (NFIP) regulations.

In the description of levees, the submitting Mapping Partner shall identify any levees that have been certified by another Federal agency to provide flood protection, although they may not meet FEMA criteria, and the protected reaches.

J.1.3 Section 3.0, Engineering Methods

For Subsection 3.1, Hydrologic Analyses, the following information is to be included:

- A description of the hydrologic analyses, including the computer model used, for all flooding sources studied using detailed methods;
- A Summary of Discharges Table, providing a summary of drainage area-peak discharge relationships for the streams studied by detailed methods; and
- A Summary of Stillwater Elevations Table, providing a summary of 10- percent-annual-chance (10-year), 2-percent-annual-chance (50-year), 1-percent-annual-chance (100-year), and 0.2-percent-annual-chance (500-year) flood elevations at all lakes and ponds studied using detailed methods and along streams in cases where elevations would create a flat profile along the studied reach.

For the Summary of Discharges Table, drainage areas for each stream are to be listed in descending order. Streams should be listed in the same order as they appear in the Flood Profiles. A sample Summary of Discharges Table is provided in the sample report in Section J.4.

For the Summary of Stillwater Elevations Table, flooding sources are to be listed alphabetically; locations are to be listed from upstream to downstream. A sample Summary of Stillwater Elevations table is provided in the sample report in Section J.4..

For Subsection 3.2, Hydraulic Analyses, the following information is to be included:

- Method for developing cross sections for all streams studied by detailed methods;
- Method for determining the dimensions of hydraulic structures;
- Method for assigning channel roughness factors (Manning's "n") and the "n" values for all streams studied by detailed methods (channel and overbank areas);
- Method for obtaining water-surface elevations for all streams studied by detailed methods, including the computer model used;

- Method for obtaining starting water-surface elevations for all streams studied by detailed methods;

- Method for studying wave height and wave runup; lacustrine, ice jam, and alluvial fan flooding; and areas of shallow flooding (where applicable), including the computer model used;

- Transect Descriptions, when applicable, that includes the transect number, location, 1-percent-annual-chance stillwater elevation, and maximum 1-percent-annual-chance wave elevation;

- A description of the hydraulic analyses for approximate flooding sources, if performed;

- Transect Data Table, when applicable, that includes the flooding source (with the affected transects); 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater elevations; zone designation; and Base Flood Elevation (BFE); and

- Transect Location Map, when applicable.

For Section 3.3, Vertical Datum, the following information is to be included:

- Vertical datum and releveling dates, if any; and

- Conversion factors, if any.

J.1.4 Section 4.0, Floodplain Management Applications

For Subsection 4.1, Floodplain Boundaries, the following information is to be included:

- All source maps used, including scale, contour interval, date of map, and type of map (e.g., topographic, compiled from aerial photographs) or information used to create the work map; and

- All maps or methods used to delineate floodplain boundaries for flooding sources studied by approximate methods.

For Subsection 4.2, Floodways, the following information is to be included:

- Names of all streams for which regulatory floodway widths extend beyond the corporate limits;

- Names of all streams affected by backwater from another stream;

- Methods for computing regulatory floodway(s);

- Floodway Data table;
- Reason(s) why regulatory floodway was not computed and delineated for certain streams or portions of streams; and
- Any unusual procedures such as State-imposed or locally imposed surcharge limits of less than 1.0 foot for regulatory floodway delineations.

J.1.5 Section 7.0, Other Studies

For this section, the submitting Mapping Partner shall identify and reference all other FISs for contiguous communities and any other published reports or available data dealing with related flooding sources. All disagreements and discrepancies must be noted and/or resolved.

J.1.6 Section 9.0, Bibliography and References

For this section, the submitting Mapping Partner shall list references with complete information, including date, place of publication, and scale (as applicable).

J.1.7 Exhibits

For Exhibit 1, Flood Profiles, new Flood Profiles or revised Flood Profiles for all flooding sources studied by detailed methods are to be listed. See Subsection J.2.3.1 for Flood Profile specifications.

J.2 Preparation of Flood Insurance Study Reports

The FIS report shall include text, cover, tables, photographs (if available), Flood Profiles (if applicable), floodway schematic (if applicable), transect schematic (if applicable), and transect location map (if applicable). The processing Mapping Partner shall follow the specifications in this section in preparing Preliminary and Final versions of new and revised FIS reports. Requirements for format and text content, standard paragraphs and language, graphic specifications, and organization are summarized in the subsections that follow.

J.2.1 Format and Text Content Specifications

The sample report located in Section J.4 presents the overall format and sections required to produce an FIS report for final printing and is supplemented by Figures J-1 through J-15 at the end of this Appendix.

The content of the sample single-jurisdiction report is fictional. The sample presents an original report that has been revised twice by adding an additional section to the report. The sections, subsections, paragraphs and language required for every FIS report appear in bold-faced type. The language of the specific content within the sections can be used as guidance. The subsections below present the different formats of FIS reports and list the additions or changes to the sample report required for each.

Additional guidance and requirements for the processing Mapping Partner are as follows:

- The margins of all pages are to be approximately 1 inch to allow for binding of the printed FIS report.

- The final camera-ready text are to be typed, single-spaced, on 8 ½" x 11", good-quality non-grain paper. Negatives of the text are not required for camera-ready delivery to GPO.

- Most of the required tables are to be typed as part of the text; hence, they require no graphics preparation. They may be produced in a landscape or portrait format, with preference given to the best presentation based on the size of the tables. The sample report in Section J.4 and Figures J-7 through J-15 at the end of this Appendix provide guidance on table presentation.

- The format of Section 9.0, Bibliography and References, in the sample report is one method that may be used to present the references within the body of the FIS report and in Section 9.0. Other industry-accepted formats may be used as long as the application of the format is consistent within the FIS report. If an FIS report is revised or the FIS report is revised by Addendum (see Subsection J.2.1.6), the existing format must be followed.

- The opening page of all FIS reports is the Notice to Flood Insurance Study Users. When the results of a Flood Map Project are issued in Preliminary form for community review, FIS reports are to include the following note at the bottom of that page if any unchanged components have been omitted from the Preliminary FIS.

  The Preliminary FIS report does not include unrevised Floodway Data tables or unrevised Flood Profiles. These unrevised components will appear in the final FIS report.

  This note is to be removed before the FIS report is submitted to the MSC for printing by the U.S. Government Printing Office.

- The Mapping Partner shall be aware that if the vertical datum used for the Flood Map Project or map revision is North American Vertical Datum of 1988 (NAVD88) or if the vertical datum was changed from National Geodetic Vertical Datum of 1929 (NGVD29) to NAVD88, all FIS report components including, but not limited to, the Floodway Data table and the Flood Profiles, shall reflect the correct datum title.

J.2.1.1 Map Initiatives Format

The Map Initiatives Format is used to present all flood hazard information on the Flood Insurance Rate Map (FIRM) including floodplain boundary delineations, floodway boundary delineations, zone labels, BFEs, and cross sections. When a FIRM is prepared in the Map Initiatives Format, some specific text changes are to be made to the FIS report. Guidance on when an FIS report is to be prepared in the Map Initiatives Format is provided below.

First-Time Flood Insurance Study Report

The processing Mapping Partner shall use the Map Initiatives Format for a single-jurisdiction FIS report for a community that does not have an effective FIS report. The sample FIS report in Section J.4 (without the additional revisions section) presents the requirements for a first-time FIS report prepared in the Map Initiatives Format.

Conversion of Standard Format to Map Initiatives Format

The processing Mapping Partner shall use the Map Initiatives Format also when converting the FIS report from the Standard Format; that is, to combine flood hazard data and floodway delineations previously printed on FIRMs and Flood Boundary and Floodway Maps (FBFMs) into a single FIRM format. Requirements concerning format and organization are provided below.

The following information is to be included at the end of the Notice to Flood Insurance Study Users included in the sample report in Section J.4:

> **Selected Flood Insurance Rate Map panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:**

Old Zone(s)	**New Zone**
Al through A30	**AE**
VI through V30	**VE**
B	**X**
C	**X**

The following paragraph is to be completed and substituted for the first paragraph in Subsection 1.1 of the FIS report:

> **This Flood Insurance Study (FIS) report has been prepared to revise and update a previous FIS report/Flood Insurance Rate Map (FIRM) for the [<u>Full Community Name</u>]. This information will be used by [<u>Community Name</u>] to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.**

J.2.1.2 Partial Map Initiatives Format

For some FIS reports, FEMA may direct the processing Mapping Partner to prepare the FIRM and FIS report in the Partial Map Initiatives Format. That is, FEMA may request that the processing Mapping Partner prepare only certain FIRM panels and certain portions of the FIS report in the Map Initiatives Format. Specific requirements for the format and organization of an FIS report prepared in the Partial Map Initiatives Format are provided below.

The following information shall be included at the end of the standard Notice to Flood Insurance Study Users included in the sample report in Section J.4:

> **Selected Flood Insurance Rate Map panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways and cross sections). In addition, former flood hazard zone designations have been changed as follows.**

Old Zone(s)	**New Zone**
A1 through A30	**AE**
V1 through V30	**VE**
B	**X**
C	**X**

> **Initial FIS Effective Date: January 20, 1990**
>
> **Revised FIS Dates: April 15, 1994 – to change special flood hazard areas, to change base flood elevations, to change zone designations and to add special flood hazard areas, dated May 13, 1990, from Fulton County, Pennsylvania.**
>
> **August 22, 1997**

This additional information for the Notice to Flood Insurance Study Users provides for the addition of the Reason for Revision with the revision dates. This addition is to be used when room is limited on the FIRM panel. The most recent date represents the "current" revision, and the reasons for this revision would appear on the FIRM legend. See Appendix K of these Guidelines for a complete discussion of map dates in the legend.

J.2.1.3 Countywide Format

The Countywide format is used to present a unified study of flood hazards across community boundaries within a county. The processing Mapping Partner generally shall follow the sample report provided in Section J.4; however, several changes shall be made to the standard wording and tables. Those changes are presented below in the order of their appearance in the FIS report.

The following paragraph is to be completed and substituted for the first paragraph in Subsection 1.1 of the FIS report:

> **This Flood Insurance Study (FIS) revises and supersedes the FIS reports and/or Flood Insurance Rate Maps (FIRMs) [/Flood Boundary and Floodway Maps] in the geographic area of ______________ County, State, including the [Complete Names of Incorporated Communities, in Alphabetical Order] and unincorporated areas of __________ County (hereinafter referred to collectively as _________ County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by ________ County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.**

The following sentence is to be completed and substituted for the first sentence in Subsection 2.1 of the FIS report:

> **This FIS covers the geographic area of ___________ County, [State].**

The following paragraph is to be added at the end of Section 6.0 of the FIS report:

> **The current FIRM presents flooding information for the entire geographic area of ________ County. Previously, separate Firms were prepared for each identified floodprone incorporated community and the unincorporated areas of the county. Historical data relating to the maps prepared for each community are presented in Table ___.**

A Community Map History table is to be added. Format and specifications for this table are presented in Figure J-15 at the end of this Appendix.

J.2.1.4 Existing Data Studies/Restudies

Existing Data Studies/Restudies are processed when analyses that are conducted independently for purposes other than the NFIP are submitted to update flood hazards shown on NFIP maps. For Existing Data Studies/Restudies, the processing Mapping Partner shall produce the FIS reports in the format provided in the sample report in Section J.4, with the name of the agency that is the source of data cited in Subsection 1.2 of the FIS report.

J.2.1.5 Flood Insurance Study Report/Flood Insurance Rate Map Combinations

For small-scale Flood Map Projects and map revisions, especially those that include single-panel FIRMs, the processing Mapping Partner may have the option of printing the FIS report directly on the FIRM panel. Additional information on this mapping format is provided in Appendix K; an example may be ordered from the FEMA MSC by calling 1-800-358-9616. The decision to process a study in this format shall be made by the FEMA Lead.

J.2.1.6 Revisions by Addendum

If the processing Mapping Partner is directed to revise an FIS report but not reformat it, the processing Mapping Partner shall ensure that the format, organization, and content of the report follow that of the existing FIS report, with some exceptions. The processing Mapping Partner shall take the most cost-effective approach to updating the FIS report; the minimum work required is the creation of an addendum, or additional section, that shall be placed at the end of the FIS report. This section, entitled "Revisions Description," (Section 9.0 for reports prepared in Standard Format, Section 10.0 for reports prepared in Map Initiatives Format) is to provide information regarding the significant revisions that were made since the FIS report was last printed. The processing Mapping Partner shall include a subsection for each revision, and shall ensure that the subsections are numbered consecutively (e.g., 9.1, 9.2, for reports prepared in Standard format; 10.1, 10.2, for reports prepared in Map Initiatives format). Examples of the added section can be found in the sample report in Section J.4.

If the addendum format is used, the processing Mapping Partner shall include the information below in the Notice to Flood Insurance Study Users found in the sample FIS report. The processing Mapping Partner shall substitute Section 10.0 with Section 9.0 and Sections 1.0 through 9.0 with Sections 1.0 through 8.0 if the effective FIS report is in Standard format.

> **This FIS was revised on [add new effective date]. Users should refer to Section 10.0, Revisions Description, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this FIS report should be aware that the information presented in Section 10.0 supersedes information in Sections 1.0 through 9.0 of this FIS report.**

J.2.2 Graphic and Table Elements

This section discusses requirements for the graphic and table elements of an FIS report, including the cover, transect location map, transect schematic, floodway schematic, Floodway Data table, and Flood Insurance Zone Data table. Graphic examples of report elements are provided in the sample report in Section J.4 and in Figures J-1 through J-5 at the end of this Appendix.

J.2.2.1 Cover

The Mapping Partner shall use the existing cover of the FIS report if it was prepared according to the requirements below. If the Mapping Partner creates a new FIS report, the cover need not include the outline of the subject county and State. The final camera-ready cover shall be provided on 9” x12” contact negative film.

The following are requirements for the presentation of the final FIS report cover:

- Where applicable, the effective date or revised date (matching that shown on the FIRM) is to be shown.

- The legal name of the community (e.g., City of _________, Township of ______), the County name, and the State name is to be shown. The legal name may be obtained by requesting a letterhead from the community.

- If the FIS report is to be printed in two or more volumes, a separate cover is to be prepared for each volume, indicating the appropriate number of the volume. See Figures J-1, J-2, and J-3 at the end of this Appendix for presentation requirements.

- Countywide FIS report covers are to include a list of the names and community identification numbers of the county and all incorporated communities, including non-floodprone communities.

J.2.2.2 Vicinity Map

If the effective FIS report for a subject community includes a Vicinity Map, the processing Mapping Partner shall remove the vicinity map when preparing the revised FIS report. If a new FIS report is created, the processing Mapping Partner shall not create a Vicinity Map.

J.2.2.3 Transect Location Map

For Flood Map Projects and map revisions that include wave height or wave runup analyses, the locations of transects used in the analyses are to be shown on a Transect Location Map. When a Transect Location Map is required, the processing Mapping Partner shall prepare the frame according to the specifications given in the sample FIS report in Section J.4. The processing Mapping Partner shall prepare the final Transect Location Map on 9” x 12” contact negative film.

J.2.2.4 Flood Photographs

If flood photographs are to be used in the FIS report, the processing Mapping Partner shall submit the screened photographs set in their correct locations in the FIS report. The processing Mapping Partner may prepare the photographs in positive or negative camera-ready form.

J.2.2.5 Schematics

The body of the text is to include a floodway schematic and, where applicable, a transect schematic. The processing Mapping Partner shall refer to the sample report in Section J.4 and to Figure J-5 at the end of this Appendix for requirements for the schematics.

J.2.2.6 Floodway Data Table

A Floodway Data table is to be created for each flooding source for which a regulatory floodway has been designated on the FIRM or FBFM. Floodway data are to be shown for each cross section shown on the FIRM or FBFM. Cross-section labels must be consistent with the FIRM, FBFM, and Flood Profiles. The water-surface elevations in the "Regulatory" column must be identical to the elevations shown on the Flood Profiles. The "Without Floodway" column must contain the natural 1-percent-annual-chance (100-year) water-surface elevations of streams computed without consideration of backwater from other flooding sources. These two columns will contain identical elevations except in confluence situations where regulatory elevations are determined by another flooding source.

Cross-section data may be shown for areas of backwater flooding; however, elevations in the "Without Floodway" column of the Floodway Data table must be footnoted as follows:

> "Elevation Computed Without Consideration of Backwater Effects From (Source of Flooding)."

The words "Backwater Effects" are to be replaced with "Tidal Effects," "Overflow Effects," "Ice Jam Effects," or "Storm Surge Effects," to reference the appropriate flooding situation.

Where a rise in energy grade has been used to determine the regulatory floodway, the computed change in water-surface elevation must be shown, even though these changes may be small. When negative surcharges are encountered, the "Increase" column must be shown as 0.0, and the value in the "With Floodway" column must be the same as the value in the "Without Floodway" column. In general, when bridge cross-section data are included in the table, only the data for the cross section at the upstream face of the bridge is to be provided on the Floodway Data table.

The regulatory floodway width values shown on the Floodway Data table must be rounded to the nearest whole foot. When a part of a regulatory floodway is outside the corporate or county limits and the width within the corporate or county limits is not shown, the "Width" column must be footnoted as follows:

"This Width Extends Beyond the Corporate/County Limits."

When both the total width and the width within the corporate/county limits are known, the "width" column must be footnoted as follows:

"Width/Width Within Corporate (County) Limits."

The specifications for the Floodway Data table are provided in the sample report in Section J.4.

J.2.2.7 Flood Insurance Zone Data Table

For revised FIS reports that are kept in the Standard Format, flood insurance zone data is to be tabulated at the direction of the FEMA Lead. Flood insurance zone data is to be included in the appropriate format for each flooding source studied by detailed methods. However, backwater reaches of a tributary stream are not to be listed when the main stream has also been studied and zone data are listed for it in the table. The specifications for the Flood Insurance Zone Data Table are provided on Figure J-15.

In situations where the FIRM is being produced, in whole or in part, in the Map Initiatives Format, the processing Mapping Partner shall remove the Flood Insurance Zone Data Table from the FIS report.

J.2.3 Flood Profiles

Flood Profiles generated by the submitting Mapping Partner may be used for final publication if they are technically accurate and legible.

J.2.3.1 Flood Profile Specifications

The Flood Profiles for each stream studied by detailed methods must be drawn in a standard format, using the format, symbol, and type specifications shown on the Flood Profile in the sample report in Section J.4. If a main stream has backwater effects on a tributary stream, and the flood elevations computed for the main stream are revised, the Flood Profiles for the tributary stream must be revised accordingly.

Flood Profiles must not be plotted for more than one flooding source on each panel, with one exception. When a main stream goes by one name to a point where it is formed by the confluence of two small tributary streams, one of the tributary streams shall be selected as a logical continuation of the main stream. The Flood Profile shall then continue, uninterrupted, up the tributary. The Flood Profile panel must show both the stream names in the title block and indicate the point where the name change occurs. The main stream stationing and cross-section sequencing are to continue up the tributary stream. Each stream must be treated separately in the text and tables. Flood Profiles must be continuous for the entire stream length studied.

When the Flood Profiles are prepared for the first time, or existing Flood Profiles are revised, the processing Mapping Partner shall not include the 10-, 2-, or 0.2-percent-annual-chance flood lines. The water-surface profiles of the 1-percent-annual-chance flood and the channel bottom (streambed) or hydraulic base line only are to appear.

The processing Mapping Partner shall ensure that breaks in the Flood Profile do not occur for stream segments passing through areas not included or where the stream and floodplains leave and return to the community. Flood Profiles are also required for those watercourse segments that may not lie within the community, but do contribute to the flood inundation within the community. Profile limits are to include areas where the stream has left the community, but flood inundation continues. The processing Mapping Partner shall label those limits that are located outside the community as "Limit of Flooding Affecting Community."

On the Flood Profiles of tributary streams, the processing Mapping Partner shall label the 1-percent-annual-chance flood backwater from the main watercourse or water body as "Backwater From (Main Stream Name)."

The processing Mapping Partner shall ensure all drawdowns are eliminated from the Flood Profiles.

Any well-documented high-water marks of past major floods that are discovered during the reconnaissance should be shown and referenced on the Flood Profiles.

Scale

An elevation scale (vertical) of 1 inch equals 1, 2, 5, 10, or 20 feet is to be used. Use of non-whole-foot scales (e.g., 1 inch = 2.5 feet) must be approved by the FEMA Lead. Elevations must be shown on the left side of the grid at 1-inch intervals within the profile elevation range. Elevations need not be shown on the right side of the grid. The profile plots must agree to within 1/20 inch of the 1-percent-annual-chance regulatory flood elevations provided in the Floodway Data table.

The stream distance scale that is used must be chosen so that the profile measures at least 3 inches in length and the average slope across the profile page does not exceed 35 degrees. When determining scales, the Mapping Partner shall consider the total number of Flood Profiles that will be created. A horizontal scale of 1 inch equals 100, 200, 400, 500, 1,000, or 2,000 feet is preferred. The horizontal scale must be labeled at 1-inch intervals along the bottom edge of the grid and legend box.

The use of miles, and fractions thereof, is to be avoided except for major flooding sources where a reference system in miles has already been established. However, the units for any one flooding source must be consistent. Stationing notation (i.e., 100 + 00) is to be converted into conventional feet measurement. Stationing is to be referenced from a physical location such as a confluence or structure. Corporate limits are only be used as a last resort for Flood Profile stationing.

Downstream elevations are to begin on the left edge of the grid. Stream distance is measured along the stream channel centerline or some other hydraulic base line as defined and delineated on the work maps submitted by the submitting Mapping Partner. Distance and elevation units used on a Flood Profile must be consistent with the units provided in the computer printout and with the units used on the Floodway Data table.

Cross Sections

Flood Profile cross sections must be plotted at distances that are consistent with tabular data and work map locations. Cross sections for each stream are to be labeled in alphabetical sequence, beginning at the downstream study limit. For each stream, the labels are to begin with A, B, C, and continue to Y, Z, AA, AB, … AZ, BA, BB, BC, and so forth. Cross-section sequences mustl not be carried over from one stream to another unless the hydraulic model is continuous from one stream to another. Cross-section labels are to be shown within hexagonal shapes; when close spacing necessitates, hexagons are to be stacked, as shown on the sample Flood Profile in the sample FIS report in Section J.4. The location of the cross section indicated by the placement of the hexagon must not deviate more than 0.05 inch from the location presented on the Floodway Data table. For short stream segments that meander beyond the detailed study limits, and for stream segments for which no regulatory floodway is computed, selected sequentially labeled cross sections may be shown on the Flood Profile.

Physical Features

All hydraulic structures, points of confluence, corporate limits, and other pertinent information must be indicated on the Flood Profiles. Points of confluence for entering tributaries are to be labeled as follows:

"Confluence with (Stream Name)."

For bridges, top of road (TOR), and low steel (LS) are to be represented by the conventional symbol, "I," where TOR is represented by the upper horizontal bar, LS by the lower bar, and the center of the structure by the vertical bar. For high-level bridges where the symbol cannot be shown on the Flood Profile, TOR and LS elevations are to be indicated.

For culverts, the symbol is to represent the overburden. The culvert pipe is assumed to be the open area between the streambed and the bottom of the overburden.

Restudied Streams

In preparing Flood Profiles for restudied streams, the processing Mapping Partner shall maintain the existing format. For example, the processing Mapping Partner shall use the horizontal and vertical scales used in the effective FIS report. Stationing notation and datum reference must be consistent with effective Flood Profiles to perform any modifications in a cost-effective manner.

The processing Mapping Partner shall ensure that all Flood Profiles for restudied streams reflect 1-percent-annual-chance (100-year) flood elevations and reflect the streambed or hydraulic baseline. The processing Mapping Partner shall ensure that all structures reflected on the effective Flood Profiles as well as any new structures are depicted on the revised Flood Profile. All cross sections shown on the revised FIRM (or FBFM) and in the Floodway Data table must be clearly reflected on the submitted profiles. The processing Mapping Partner shall obtain approval from the FEMA Lead for deviations from the effective Flood Profile format.

The processing Mapping Partner shall adjust the backwater area on Flood Profiles for tributaries that flow into a revised stream to reflect the revised elevations.

Reach and Zone Labels

In situations where the FIRM is being produced, in whole or in part, in the Map Initiatives Format, the processing Mapping Partner shall remove reach and zone labels from all Flood Profiles.

J.2.3.2 Flood Profile Production

Flood Profiles may be prepared digitally or manually; digital files are preferred.

Digital Flood Profile Production

Two software applications for profile creation are available for download, free of charge, from the FEMA website (http://www.fema.gov/mit/tsd/FRM_soft.htm).

The first application is RASPLOT. Refer to the RASPLOT User's Manual, available for separate download, for guidance regarding its use.

The second application is FISPLOT. The FISPLOT program allows users to create drawing interchange format (*.DXF) files from HEC-2 input and output files. FISPLOT may later be enhanced so that it can generate Flood Profiles from other backwater computer models, such as WSPRO and WSP2.

The FISPLOT-generated *.DXF files can then be imported into AutoCAD® and all the appropriate FEMA symbols, such as bridge deck information, are displayed in an AutoCAD® drawing (*.DWG) file.

However, equivalent software may be used, provided that the output file produces a Flood Profile that meets the requirements above. Mapping partners should contact the RPO to discuss using alternative software platforms.

Manual Flood Profile Production

Flood Profiles are to be neatly drawn and lettered on standard 11"x17", 10x10 to the inch grid, mylar profile sheets. At the submitting Mapping Partner's request, the FEMA Lead may provide assistance in obtaining blank standard mylar profile sheets. Use of non-standard profile sheets (i.e., continuous computer-generated profile sheets or paper copy vs. mylar) must be coordinated and approved by the FEMA Lead. If the use of a continuous profile sheet is approved, the Mapping Partner must assure that the selected vertical scale would not necessitate replotting the profiles; i.e., the Mapping Partner responsible for producing the final Flood Profile should be able to trace-draft the submitted continuous profile sheet onto standard 11"x17" mylar profile sheets.

J.3 Volume Printing

The processing Mapping Partner shall ensure that the following requirements are met when appropriate:

- FIS reports exceeding 150 pages in length shall be subdivided into two or more volumes.
- No more than 100 pages shall be included in any volume.
- Where possible, reports shall be subdivided so that volumes begin and end at logical breakpoints; however, the number of volumes must be minimized.
- One listing, entitled "Tables of Contents," is be prepared for all volumes.
- A copy of the complete Table of Contents shall appears in each volume of the FIS report.

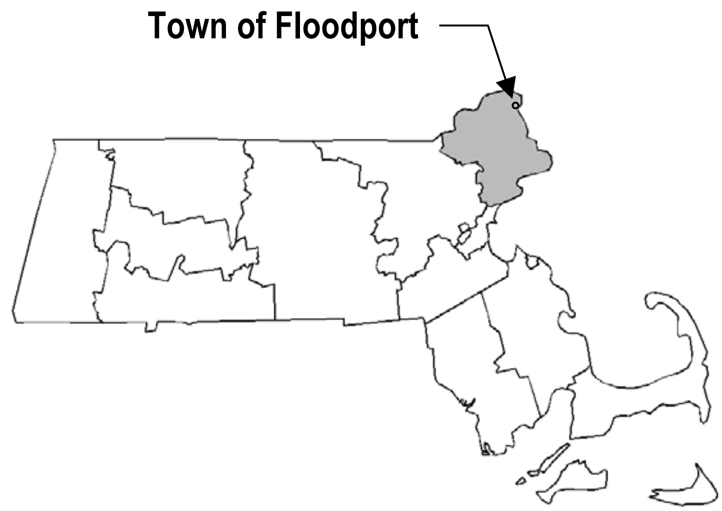
J.4 Sample Flood Insurance Study Report

The following sample single-jurisdiction FIS report, for a fictional Massachusetts community, is in the final form to be submitted to the MSC for printing by the U.S. Government Printing Office. The sample FIS report is for a community subject to both riverine flooding and coastal flooding (i.e., wave height and runup hazards). This FIS report has been prepared in the Map Initiatives format with an extra section added as an addendum at the end of the report.

The following sample FIS report is intended only as a graphic example of a report format; the content is not intended to be an authoritative example of an actual FIS report The sections, subsections, paragraphs, and language required for every FIS report are in **bold-faced** type. The language of the specific content within the sections and subsections can be used for guidance.

FLOOD INSURANCE STUDY

TOWN OF FLOODPORT, MASSACHUSETTS
FLOOD COUNTY



REVISED:
August 31, 2001

Federal Emergency Management Agency

COMMUNITY NUMBER - 259999

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map Repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revised and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

This FIS report was revised on August 31, 2001. Users should refer to Section 10.0, Revisions Description, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this report should be aware that the information presented in Section 10.0 supersedes information in Sections 1.0 through 9.0 of this FIS report.

FIS Effective Date: January 15, 1992

Revised FIS Dates: November 11, 1992 (Flood Insurance Rate Map only)
December 3, 1996
August 31, 2001

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FLOOD INSURANCE STUDY

TOWN OF FLOODPORT, FLOOD COUNTY, MASSACHUSETTS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Floodport, Flood County, Massachusetts, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by John Brown Engineering Corporation, **for the Federal Emergency Management Agency** (FEMA), under Contract No. H-1983. **This work was completed in** December 1985.

1.3 Coordination

The initial Consultation Coordination Officer (CCO) meeting was held on April 12, 1983, **and attended by representatives of FEMA,** the Town of Floodport, and the study contractor.

Coordination with Town officials and Federal, State, and regional agencies produced information pertaining to floodplain regulations, community maps, flood history, and other hydrologic data.

The U.S. Army Corps of Engineers (USACE) and the National Oceanic and Atmospheric Administration (NOAA) were contacted for data on tide elevations.

Coordination with these agencies concerning coastal flood elevations was continued during the study. The Massachusetts Department of Public Works (MDPW) was contacted for information on historic flooding and high-water marks. Vertical control data used to establish the network of elevation reference marks were provided by the MDPW, NOAA, U.S. Geological Survey (USGS), and U.S. Coast and Geodetic Survey.

An intermediate CCO meeting was held on February 14, 1984, and attended by representatives of FEMA, the community, and the study contractor. The purpose of this meeting was to present preliminary results of the study to the community.

The results of the study were reviewed at the final CCO meeting held on December 1, 1986, **and attended by representatives of FEMA**, the community, and the study contractor. **All problems raised at that meeting have been addressed.**

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the incorporated **areas of the** Town of Floodport, Flood County, Massachusetts.

Riverine flooding on the Rocky River from approximately 100 feet downstream of U.S. Route 1 to the upstream corporate limits was studied by detailed methods. Tidal flooding from the Atlantic Ocean, including wave action, and the Merrimack River was also studied by detailed methods.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through December 1990.

Keiths and Richards Creeks were studied by approximate methods for their lengths within the Town of Floodport.

Approximate analyses were used to study those areas having low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and the Town of Floodport.

2.2 Community Description

The Town of Floodport is located in northeastern Flood County, in northeastern Massachusetts, approximately 35 miles north of the City of Boston. It is bordered by the Atlantic Ocean to the east; the Town of Rowley to the south; the Towns of West Newbury, Groveland, and Georgetown to the west; and the City of Newburyport to the north.

Because of its proximity to the Atlantic Ocean, Floodport attracts both a permanent and transient population. According to the 1980 State census, the town had an estimated population of 4,239.

The population density in 1980 was 167 persons per square mile (Massachusetts Department of Commerce, 1980). Floodport is experiencing growth pressure, and coastal seasonal homes are being converted to year-round residences. It is estimated that the population of the town will increase approximately 51 percent by 1990 (New England River Basins Commission, 1975).

The total area contained within the corporate limits of Floodport is 25.4 square miles. Of the total area, only 8.4 percent is classified as urban land. The remaining land uses are as follows: forest, 34.6 percent; wetlands, 38.2 percent; agriculture and open land, 16.8 percent; mining and waste disposal, 0.3 percent; and recreation, 1.7 percent (Massachusetts Agricultural Experiment Station, 1974).

Development along the Floodport coast is primarily residential (permanent and seasonal) and recreational. The coast is characterized by the sand dunes of the barrier beach, Plum Island, which extends from the confluence of Plum Island Sound and the Ipswich River north to the Merrimack River. Residential development is located on the northern portion of Plum Island. The remainder of Plum Island, except Camp Sea Haven, is part of the Parker River National Wildlife Refuge. To the west of Plum Island is an extensive system of salt marshes associated with the Mill and Plum Island Rivers. The Plum Island River, a tidal creek, is a waterway for small boats between the Merrimack River and Plum Island Sound. Residential development is located west of the salt marshes, approximately 2 miles from the coast. Residential development is also located in the southwestern corner of town.

The coast is relatively flat, ranging from sea level to an approximate elevation of 30 feet. Inland, the topography is level, with an average elevation of 50 feet. Small hills, with elevations of 100 to 150 feet, are located in the southern and southwestern portions of town. The soils are predominantly wet throughout eastern and central Floodport. Northwestern Floodport has rough and stony soils. Floodport has a tidal shoreline of 48.3 miles (Massachusetts Department of Commerce, 1975).

The Rocky River and its tributaries drain most of the town. The river, which is 21 miles long and has a drainage area of approximately 35 square miles, has its headwaters in West Boxford and flows northeasterly until it joins Plum Island Sound in Floodport.

The climate of Floodport is variable. The average annual precipitation is approximately 43 inches; the average annual snowfall is approximately 47 inches. The Floodport area experiences no dry season. From June to September, rainfall usually occurs as showers or thunderstorms. The thunderstorms produce heavy, sometimes excessive, amounts of rain. Throughout the year, the heaviest gales usually come from the northeast and east and are more common and severe during the winter. "Northeasters," as they are called, produce an abundance of rain and snow. The average annual temperature is approximately 51 °F; the mean temperatures for January and July are 28°F and 74.8°F, respectively (NOAA, 1976).

2.3 Principal Flood Problems

The low-lying coastal areas of the town adjacent to the Atlantic Ocean are subject to the periodic flooding and wave attack that accompanies storms such as northeasters. Hurricanes have not produced significant flooding in these areas. The majority of coastal storms cause damage only to low coastal roads, boats, beaches, and seawalls. Occasionally, a major storm accompanied by strong onshore winds and high tides results in surge and wave activity that causes extensive property damage and erosion.

Four of the more significant storms in the Floodport area were those of December 1901 and 1959 (approximately 160- and 15-year recurrence intervals, respectively) and February 1972 and 1978 (approximately 10- and 70-year recurrence intervals, respectively). These storms damaged harbors, marinas, and residential and commercial developments in the floodprone coastal areas.

In addition to flooding, serious shorefront erosion has occurred at Plum Island since the early 1880s, when the mouth of the Merrimack River was located approximately 0.5 mile south of its present position. Jetties, which were constructed at the turn of the century, had stabilized the entrance of the river at its present location and tended to create a buildup of the oceanfront shores on the northern end of the island.

However, since 1938, continuous recession of the shoreline has occurred, resulting primarily from severe storm surge and coincident wave action. During the severe storm that occurred on February 19, 1972, a wide fronting beach and backlying dunes were destroyed, and several cottages were damaged or destroyed. This storm made the island susceptible to further damage.

Riverine flooding has not generally been as severe as coastal flooding in the Floodport area. Extreme water levels on the Rocky River are primarily caused by runoff from heavy rainfall and snowmelt.

2.4 Flood Protection Measures

Present and future demands associated with the seasonal tourist industry will further intensify the pressure for development of floodprone coastal lands. However, the adoption of State and local development regulations concerning floodplain management will help alleviate storm-related losses (, USACE, 1971).

No major structural flood protection measures exist or are planned for the Town of Floodport.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Floodflow frequencies for the Rocky River were based on a statistical analysis of USGS gage data. These data were analyzed in accordance with criteria outlined in Bulletin 17B (Interagency Advisory Committee on Water Data, 1982). Discharge-frequency data were based on a USGS computer model (USGS, 1976). The model was run on November 20, 1983, using a systematic record of 32 years and a generalized skew coefficient; the input for, and assumptions of, the analysis were reviewed and accepted for use in this study.

Peak discharge-drainage area relationships for the Rocky River are shown in Table 1.

Table 1. Summary of Discharges

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	Drainage Area (square miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Rocky River					
At U.S. Route 1	13.6	415	685	831	1,261

In New England, the flooding of low-lying coastal areas is caused primarily by storm surge generated by extratropical coastal storms called northeasters. Hurricanes also occasionally produce significant storm surge in New England, but they do not occur nearly as frequently as northeasters.

To calculate the storm surge and total storm tide elevations produced by historic storms, storm pressures and windfields were determined. A computer model was developed to simulate these fields based on several easily obtained storm parameters of northeasters. A detailed description of this model is presented in the report entitled "Development and Verification of a Synthetic Northeaster Model for Coastal Flood Analysis" (Stone and Webster Engineering Corporation, 1978). A different model was used to simulate the windfields and pressures of the hurricanes considered in this analysis (Stone and Webster Engineering Corporation, 1977). When coupled with a computer surge model, the storm tide along the shoreline could be calculated for each storm of interest.

NOAA synoptic weather charts were searched to determine the northeasters and hurricanes that could potentially produce significant flooding in the Floodport area (NOAA, 1978). Tidal records from tide gages in the New England area were examined to verify which historic storms produced high-water elevations. For the analysis of flood levels, 165 storms that occurred between 1942 and 1978 were considered.

The flood levels associated with historic storms were simulated using a modified version of the FEMA storm surge model (Tetra Tech, Inc., 1977, and Stone and Webster Engineering Corporation, 1978). Input to the model consisted of windfields and pressures generated either by the synthetic northeaster model or a hurricane-windfield-and-pressure-field model for each historic storm selected. The study area was modeled using a square grid of sufficient resolution to accurately represent the offshore bathymetry and shoreline configuration. The grid mesh covered an area from Cape Cod Bay to north of Portsmouth, New Hampshire, including Boston Harbor. Output from the model included the time history of storm-induced stillwater elevations for the communities in the study areas. The total stillwater elevation was calibrated using historic tide elevation data at Boston, Massachusetts, and Portsmouth, New Hampshire. Thus, the historic storm-induced flood levels in Floodport could be simulated for each storm considered in the analysis.

The extent and frequency of coastal flooding were determined by conducting a frequency analysis of annual minimum tidal heights along the Atlantic coast at Floodport. Some historic storm-tide heights, consisting of both an astronomical tide and a storm-surge contribution, were determined by the mathematical simulation of historic northeasters and hurricanes described above; others, for which associated storm data were not available, were obtained by a correlation analysis using tide data from Boston or Portsmouth. The database at the Boston gage extended discontinuously from 1848 to 1978; the shorter record at Portsmouth was lengthened by a statistical correlation with data at Boston and Portland, Maine.

The annual maximums of these reproduced historic water elevations were fitted with a log-Pearson Type III distribution.

Elevations for floods of the selected recurrence intervals for the Atlantic Ocean and the Merrimack River are shown in Table 2.

Table 2. Summary of Stillwater Elevations

	Elevation (Feet)			
Flooding Source and Location	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Atlantic Ocean				
Entire Shoreline Within Floodport	8.2	8.9	9.2	9.8
Rocky River				
Entire Shoreline Within Floodport	5.9	7.2	8.2	8.9

The analyses reported in this FIS report reflect the stillwater elevations due to tidal and wind setup effects. The effects of wave action were also considered in the determination of flood hazard areas. A detailed description of the methodology employed in this analysis can be found in the report entitled "Determination of Coastal Storm Tide Levels" (Stone and Webster Engineering Corporation, 1978). Coastal structures that are located above stillwater flood elevations can still be severely damaged by wave runup, wave-induced erosion, and wave-borne debris. For example, during a northeaster in February 1978, considerable damage along the Massachusetts coast was caused by wave activity, even though most of the damaged structures were above the high-water level (USACE, 1979).

The extent of wave runup past stillwater levels depends greatly on the wave conditions and local topography.

Wave heights and corresponding wave crest elevations were determined using the methodology developed by the National Academy of Sciences (NAS) (NAS, 1977). The wave runup was determined using the methodology developed for FEMA by Stone and Webster Engineering (Stone and Webster Engineering Corporation, 1981).

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the Flood Insurance Rate Map (FIRM) represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data table in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to us the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

Cross sections for the backwater analyses were obtained from topographic maps compiled from aerial photographs (James W. Sewall Company, 1977). Below-water sections were obtained by field surveys. All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Exhibit 2).

Water-surface elevations for floods of the selected recurrence intervals were computed through use of the USACE HEC-2 step-backwater computer program (USACE, 1984). Starting water-surface elevations for the Rocky River were determined using critical depth.

Channel and overbank roughness factors (Manning’s “n” values) used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the stream and floodplain areas. The channel “n” values for the Rocky River ranged from 0.015 to 0.050, and the overbank “n” values ranged from 0.015 to 0.050.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Hydraulic analyses, considering storm characteristics, the shoreline, and bathymetric characteristics of the tidal flooding source studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shoreline.

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (USACE, 1975). The 3-foot wave has been determined as the minimum size wave capable of causing major damage to conventional wood-frame or brick-veneer structures.

A wave height analysis was performed to determine wave heights and corresponding wave crest elevations for the areas inundated by tidal flooding. A wave runup analysis was performed to determine the height and extent of runup beyond the limit of tidal inundation. The results of these analyses were combined into a wave envelope, which was constructed by extending the maximum wave runup elevation seaward to its intersection with the wave crest profile.

The methodology for analyzing wave heights and corresponding wave crest elevations was developed by the NAS (NAS, 1977). The NAS methodology is based on three major concepts. First, a storm surge on the open coast is accompanied by waves. The maximum height of these waves is related to the depth of water by the following equation:

$$H_b = 0.78d$$

where H_b is the crest-to-trough height of the maximum or breaking wave and d is the stillwater depth. The elevation of the crest of an unimpeded wave is determined using the equation:

$$Zw = S^* + 0.7H^* = S^* + 0.55d$$

where Z_w is the wave crest elevation, S_* is the stillwater elevation at the site, andH_* is the wave height at the site. The 0.7 coefficient is the portion of the wave height that reaches above the stillwater elevation. H_b is the upper limit for H_*.

The second major concept is that the breaking wave height may be diminished by dissipation of energy by natural or manmade obstructions. The wave height transmitted past a given obstruction is determined by the following equation:

$$Ht = BHi$$

where H_t is the transmitted wave height, B is a transmission coefficient ranging from 0.0 to 1.0, and H_i is the incident wave height. The coefficient is a function of the physical characteristics of the obstruction. Equations have been developed by the NAS to determine the transmission coefficient for vegetation, buildings, natural barriers such as dunes, and manmade barriers such as breakwaters and seawalls (NAS, 1977).

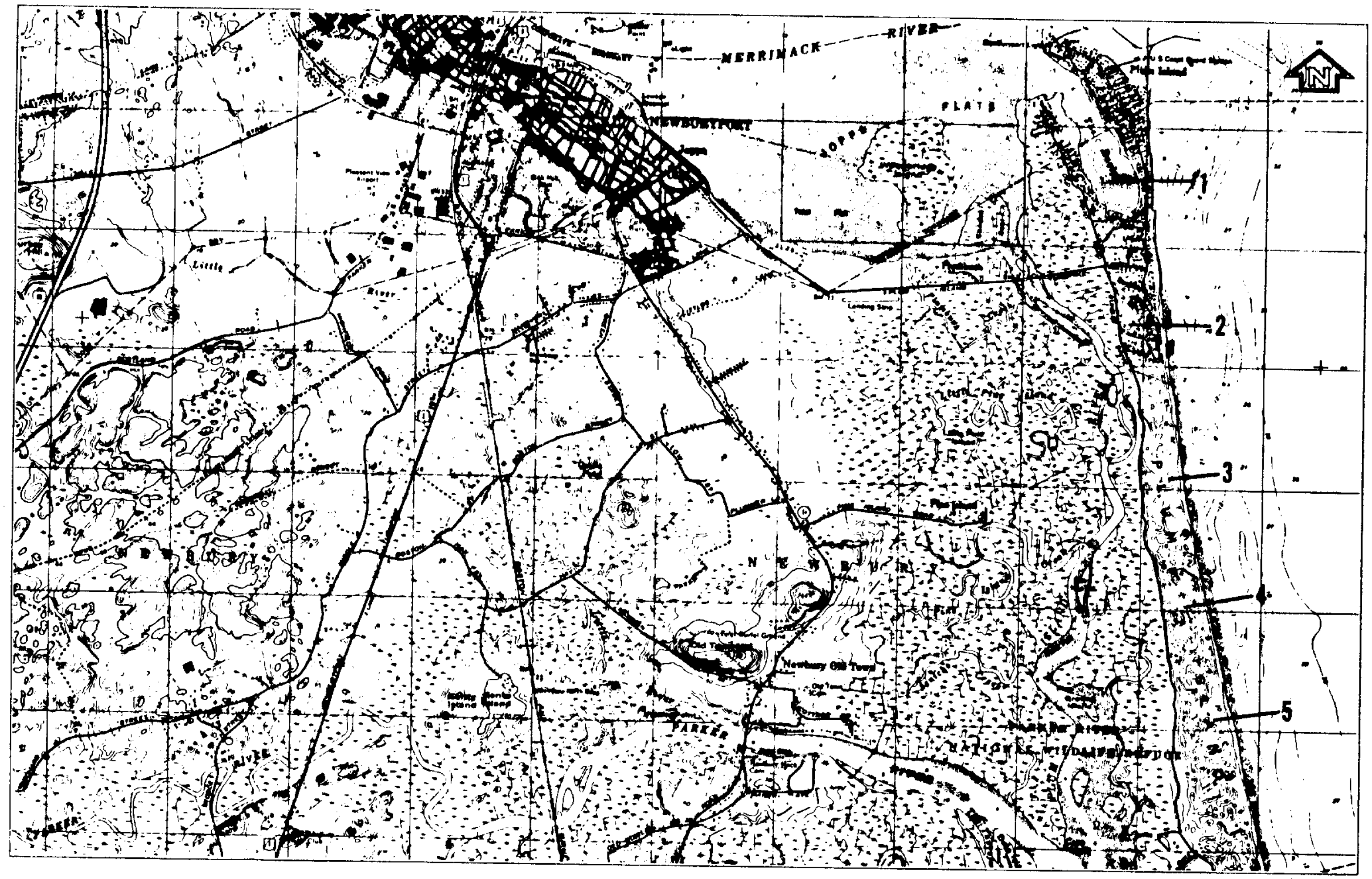
The third major concept concerns unimpeded reaches between obstructions. New wave generation can result from wind action. This added energy is related to distance and mean depth over the unimpeded reach.

The methodology for analyzing wave runup was developed by Stone and Webster Engineering Corporation (Stone and Webster Engineering Corporation, 1981). The wave runup computer program operates using an ensemble of deepwater wave heights, H_i; the stillwater elevation, S_*; a wave period, T_s; and the beach slope, m. For Floodport, wave heights range from 2 feet to 6 feet; the wave period is 4 seconds.

These concepts and equations were used to compute wave envelope elevations associated with the 1-percent-annual-chance storm surge. Accurate topographic, land-use, and land-cover data are required for the coastal analyses. Maps of the study area, prepared at a scale of 1:2,400 with a contour interval of 5 feet, were used for the topographic data (James W. Sewall Company, 1977). The land-use and land-cover data were obtained by field surveys.

Wave height and wave runup were computed along transects that were located perpendicular to the average mean shoreline. The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were located close together in areas of complex topography and dense development. In areas having more uniform characteristics, the transects were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects. Figure 2 illustrates the location of the transects for the community. A listing of the transect locations and stillwater elevations, as well as the maximum wave crest (or wave runup) elevations, is provided in Table 3.

Along each transect, wave envelope elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. Between transects, elevations were interpolated using the previously cited topographic maps, land-use data, land-cover data, and engineering judgment to determine the areal extent of flooding. The results of the calculations are accurate until local topography, vegetation, or cultural development within the community undergoes any major changes. The results of this analysis are summarized in Table 4. Historic flood damage information was also used in the determination of floodprone areas along the Floodport shoreline (UGSS, 1979).



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF FLOODPORT, MA

(FLOOD CO.)

TRANSECT LOCATION MAP

FIGURE 2

Table 3. Transect Descriptions

Transect	Location	1-Percent-Annual-Chance Flood Elevation (Feet) Stillwater	Maximum Wave[1]
1	From Plum Island Point south to Plum Island Turnpike, extended east	9.2 – 8.2	14[2]
2	From Plum Island Turnpike, extended east, to Perry Road, extended east	9.2	18[3]
3	From Perry Road, extended east, to Mason Street, extended east	9.3	14[2]
4	From Mason Street, extended east, to 8th Street, extended east	9.3	14[2]
5	From 8th Street extended east, to approximately 3,000 feet south of 1st Street	9.3	17[3]

[1]Due to map scale limitations, the maximum wave elevation is not shown on the Flood Insurance Rate Map
[2]Maximum wave height elevation
[3]Maximum wave runup elevation

Table 4. Transect Data

Flooding Source	Stillwater Flood Elevation (Feet) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance	Base Flood Elevation (BFE) (Feet)[1]
Atlantic Ocean and Merrimack River	8.2	8.9	9.2	9.8	9.14
Transect 1	5.9	7.2	8.2	8.9	8-11
Atlantic Ocean					
Transect 2	8.2	8.9	9.2	9.8	9.18
Transect 3	8.3	9.0	9.3	10.0	9-14
Transect 4	8.3	9.0	9.3	10.0	9-14
Transect 5	8.3	9.0	9.3	10.0	9-17

[1]Due to map scale limitations, BFEs shown on the Flood Insurance Rate Map represent average elevations for the depicted Zones

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the community must, therefore, be referenced to NAVD88. It is important to note that adjacent communities may be referenced to NGVD29. This may result in differences in Base Flood Elevations (BFEs) across the corporate limits between the communities.

For more information on NAVD88, see the FEMA publication entitled *Converting the National Flood Insurance Program to the North American Vertical Datum of 1988* (FEMA,June 1992), or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance (100-year) flood elevations and delineations of the 1- and 0.2-percent-annual-chance (500-year) floodplain boundaries and 1-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data table and Summary of Stillwater Elevations table. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400, **with a contour interval of** 5 feet (James W. Sewall Company, 1977).

For tidal areas without wave action, the 1- and 0.2-percent-annual-chance floodplain boundaries were delineated using topographic maps at a scale of 1:2,400, with a contour interval of 5 feet (James W. Sewall Company, 1977). For the tidal areas with wave action, the floodplain boundaries were delineated using the elevations determined at each transect; between transects, the boundaries were interpolated using engineering judgment; land-cover data; and topographic maps at a scale of 1:2,400, with a contour interval of 5 feet (James W. Sewall Company, 1977). The 1-percent-annual-chance floodplain was divided into whole-foot elevation zones based on the average wave envelope elevation in that zone. Where the map scale did not permit these zones to be delineated at l-foot intervals, larger increments were used.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, V, and VE); and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this

aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this FIS report and on the FIRM was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations have been tabulated for selected cross sections (Table 6). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

Portions of the floodway for the Rocky River extend beyond the corporate limits.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
ROCKY RIVER								
A	11430	100	433	4.3	6.3	4.0[2]	4.3	0.3
B	11900	160	915	2.0	6.3	4.6[2]	5.3	0.7
C	12200	300	1190	1.6	6.3	5.6[2]	5.6	0.0
D	13100	300	1327	1.4	6.3	6.1[2]	6.1	0.0
E	14900	250	1280	1.3	7.3	7.3	7.6	0.3
F								
G								
H								
I								
J								
K								

[1]Feet above mouth
[2]Elevation computed without consideration of backwater effects from Cobb River
(What about cross sections F through K?)

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF FLOODPORT, MA (FLOOD COUNTY)

FLOODWAY DATA

ROCKY RIVER

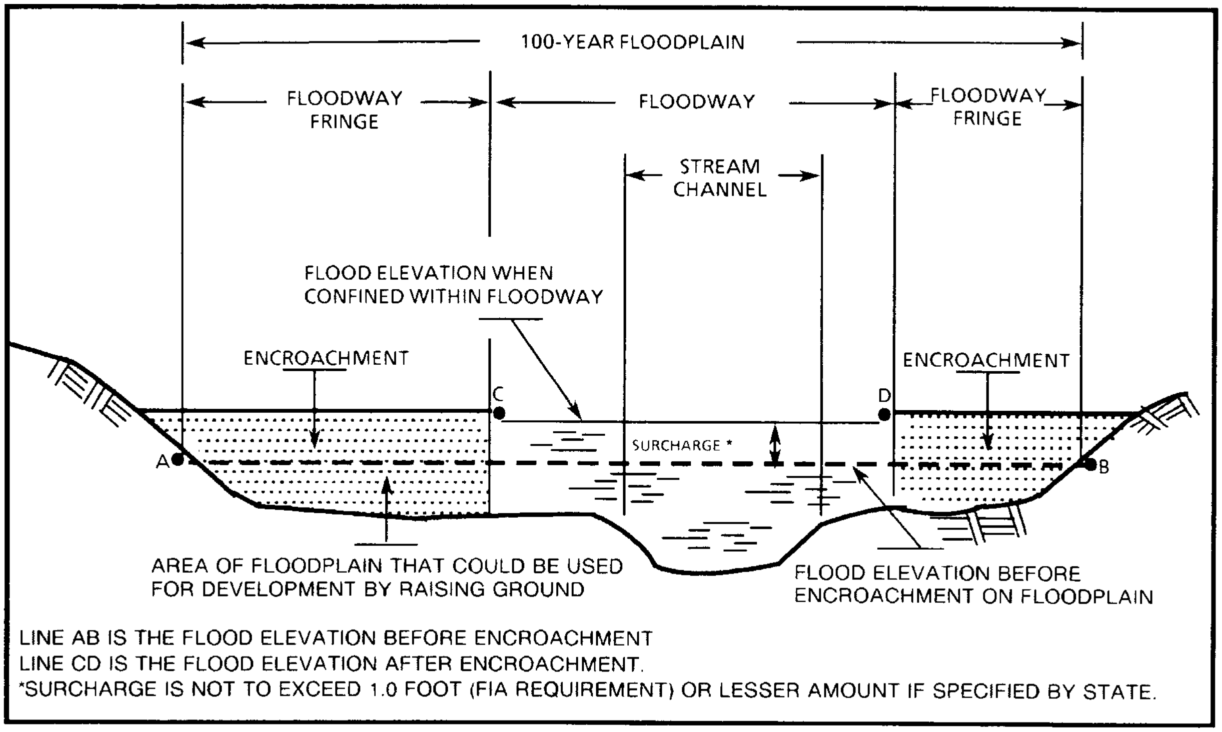


Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or base flood depths are shown within this zone.

Zone AE

Zone AE is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance risk zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance risk zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot base flood depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Zone AR is the flood insurance risk zone that corresponds to an area of special flood hazard formerly protected from the 1-percent-annual-chance flood event by a flood-control system that was subsequently decertified. Zone AR indicates that the former flood-control system is being restored to provide protection from the 1-percent-annual-chance or greater flood event.

Zone A99

Zone A99 is the flood insurance risk zone that corresponds to areas of the 1-percent-annual-chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No BFEs or depths are shown within this zone.

Zone V

Zone V is the flood insurance risk zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no BFEs are shown within this zone.

Zone VE

Zone VE is the flood insurance risk zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance risk zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or base flood depths are shown within this zone.

Zone D

Zone D is the flood insurance risk zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance risk zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

Using National Ocean Survey tide gage data (NOAA, 1984), the USACE has predicted 10-, 2-, 1-, and 0.2-percent-annual-chance flood levels at Boston, Massachusetts, and Portsmouth, New Hampshire . The USACE results compare favorably with flood levels determined in this study, considering the distance between Ipswich and the National Ocean Survey gaging stations.

FEMA has published FIS reports and FIRMs for the Towns of West Newbury (FEMA, 1979) and Georgetown (and FEMA, 1978). The results presented in the FIS report and on the FIRM for the Town of Floodville are in exact agreement with the results for those towns.

An FIS for the Town of West Newburyport is in progress (FEMA, unpublished). The results of that study will be in exact agreement with the results of this study.

This FIS report either supersedes or is compatible with all previous studies on streams studied in this report and should be considered authoritative for purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

9.0 BIBLIOGRAPHY AND REFERENCES

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U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Environment Data Service, Synoptic Weather Charts, 1978, 1976, 1972, 1970, 1969, 1968, 1967, 1966, 1962, 1961, 1960, 1959, 1958, 1957, 1954, 1953, 1950, 1944, 1940, 1931..

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Interagency Advisory Committee on Water Data, Office of Water Data Coordination, Hydrology Subcommittee, (). Bulletin No. 17B, Guidelines for Determining Flood Flow Frequency. September 1981, revised March 1982.

U.S. Department of the Interior, Geological Survey, Water Resources Investigations 78-61, *Coastal Flood of February 7, 1978, in Maine, Massachusetts, and New Hampshire*, 1979.

10.0 REVISIONS DESCRIPTION

This section has been added to provide information regarding significant revisions made since the original FIS report and FIRM were printed. Future revisions may be made that do not result in the republishing of the FIS report. All users are advised to contact the Community Map Repository at the address below to obtain the most up-to-date flood hazard data.

Town of Floodport Engineering Department

101 Main Street, Suite 999

Floodport, MA

10.1 First Revision (Revised December 3, 1996)

a. Acknowledgments

The WHAFIS analyses for this revision was performed by Tackney & Associates, Inc. FEMA reviewed and accepted these data for purposes of this revision.

b. Scope

Based on better topographic and vegetation in formation, the wave height elevations for the three additional transects along the Atlantic Ocean, south of transect 22, were computed using the WHAFIS computer model (FEMA, 1981). The additional transects are shown on Figure 2, Transect Location Map, as transects 22A, 22B, and 22C, and are described in Table 2, Summary of Stillwater Elevations. Additionally, the zone designations and BFEs were changed as a result of a revised WHAFIS analysis and to agree with the FIRM for Seaside County (FEMA, 1986).

c. Other Studies

This revision is in agreement with the published FIS for Seaside County, Massachusetts (FEMA, 1986). This revision does not reflect information from any other contiguous community.

d. References and Bibliography

Federal Emergency Management Agency, Flood Insurance Study, Town of Georgetown, Massachusetts, June 1986

Federal Emergency Management Agency,) Users Manual for Wave Height Analysis, Revised February 1981.

10.2 Second Revision (Revised August 31, 2001)

a. Acknowledgments

The hydrologic and hydraulic analyses for this revision were taken from a report titled "Floodplain Management Study, Shaw County, Massachusetts," prepared by the U.S. Soil Conservation Service (SCS) (SCS, 1984). FEMA reviewed and accepted these data for purposes of this revision.

b. Coordination

A final CCO meeting was held on September 4, 1999, to review the results of this revision.

c. Scope

This revision includes a revised detailed analysis of the Rocky River from its confluence with Big Creek to U.S. Route 1.

d. Hydrologic and Hydraulic Analyses

Revised flood discharges along the Rocky River were established by valley flood routings computed using the SCS TR-20 computer program (USCS, 1982). Peak drainage-discharge area relationships for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods are shown in Table 7.

Table 7. Revised Summary of Discharges

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	Drainage Area (square miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Rocky River					
At U.S. Route 1	13.6	420	690	850	1,298

e. Other Studies

The FIS for the Town of Watertown (FEMA, unpublished), in progress as of the date of this Revisions Description, agrees with this study.

f. Bibliography and References

Federal Emergency Management Agency, Flood Insurance Study, Town of Watertown, Massachusetts, unpublished.

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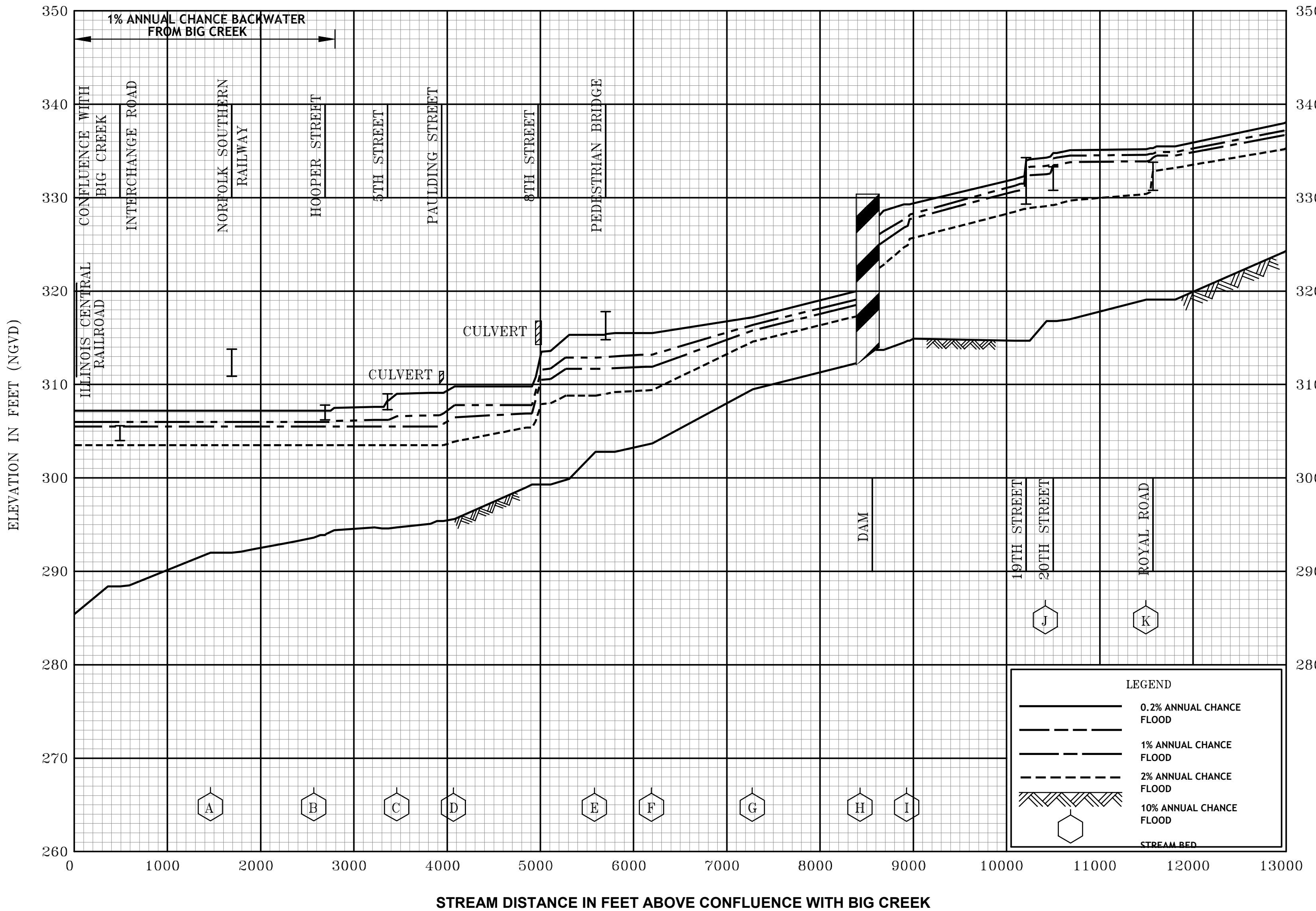


FLOOD PROFILES

ROCKY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF FLOODPORT, MA
(FLOOD COUNTY)

01P

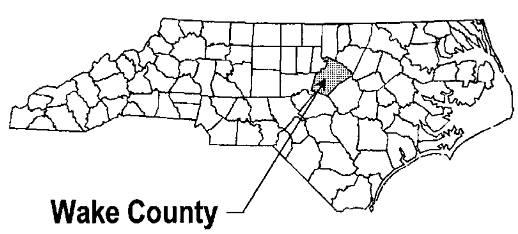
Figure J-1. Cover for Multiple-Volume Countywide Report

FLOOD INSURANCE STUDY

VOLUME 1 OF 6

WAKE COUNTY, NORTH CAROLINA AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
APEX, TOWN OF	370467
CARY, TOWN OF	370238
FUQUAY-VARINA, TOWN OF	370239
GARNER, TOWN OF	370240
HOLLY SPRINGS, TOWN OF	370403
KNIGHTDALE, TOWN OF	370241
MORRISVILLE, TOWN OF	370242
RALEIGH, CITY OF	370243
ROLESVILLE, TOWN OF	370468
WAKE COUNTY (UNINCORPORATED AREAS)	370368
WAKE FOREST, TOWN OF	370244
WENDELL, TOWN OF	370245
ZEBULON, TOWN OF	370246



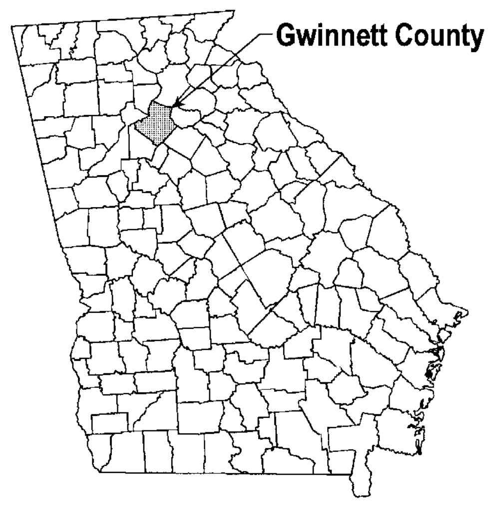
REVISED:
NOVEMBER 20, 1998

Federal Emergency Management Agency

Figure J-2. Cover for Multiple-Volume Non-Countywide Report

FLOOD INSURANCE STUDY

VOLUME 1 OF 3



GWINNETT COUNTY, GEORGIA

(UNINCORPORATED AREAS)

REVISED:
JULY 20, 1998

Federal Emergency Management Agency

COMMUNITY NUMBER - 130322

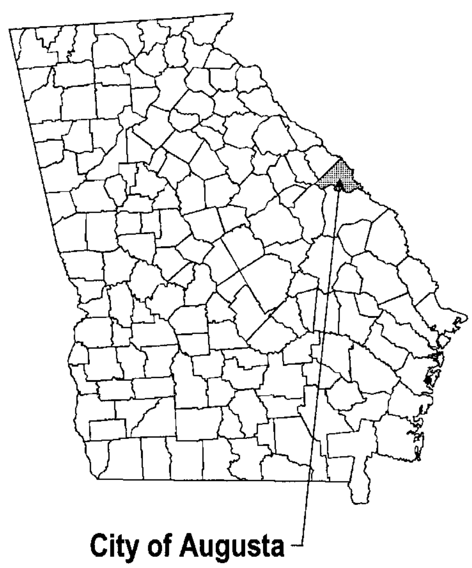
Figure J-3. Cover for Multiple-Volume Single-Jurisdiction Report

FLOOD INSURANCE STUDY

VOLUME 1 OF 2

CITY OF AUGUSTA, GEORGIA

RICHMOND COUNTY



REVISED:
MARCH 23, 1999

Federal Emergency Management Agency

COMMUNITY NUMBER - 130158

Figure J-4. Table of Contents for Multiple-Volume Countywide Report

TABLE OF CONTENTS

Table of Contents – Volume 1 – April 22, 1999

Table of Contents – Volume 1 – continued

Table of Contents – Volume 2 – April 19, 1997

Table of Contents – Volume 2 – continued

EXHIBITS - continued

Table of Contents – Volume 3 – April 21, 1999

EXHIBITS – continued

Table of Contents – Volume 3 – continued

EXHIBITS – continued

[1]Note to users: Flood Profile 191P was removed to reflect the removal of the Delaware County portion of the City of Westerville

Figure J-5. Digital Base Map Source Description Example

The hydrologic and hydraulic analyses for the August 2, 1995, countywide FIS were performed by Water Resources and Coastal Engineering, Inc., for FEMA, under Joint Venture Contract No. EMW-91-C-3360. The joint venture team consisted of Water Resources & Coastal Engineering,, Inc. and Geodyssey, Inc. That work was completed in September 1992.

For the July 16, 1997, revision, the hydrologic and hydraulic analyses for Tussing-Bachman Ditch, Bush Ditch, and Georges Creek Overland Flow were prepared by the ODNR Division of Water. These analyses were subsequently modified by Dewberry & Davis under a directive from FEMA. This work was completed in December 1995.

For this revision, the hydrologic and hydraulic analyses for the Olentangy River were taken from the Delaware County, Ohio and incorporated areas FIS (Reference 1). The analyses were prepared by Evans, Mechwart, Hambleton, and Tilton, Inc. under Contract No. EMW-94-C-4525, and subsequently modified by Dewberry & Davis under a directive from FEMA.

The digital base mapping information was provided by the Franklin County Auditor's Office, Division of Automated Mapping, 373 South High Street, 19th Floor, Columbus, Ohio, 43215-6310. Further information about the base mapping is available by contacting the Auditor's Office. These files were compiled by photogrammetric methods and meet or exceed National Map Accuracy Standards at the original compilation scale of 1"=100'. The coordinate system used for the production of this FIRM is Universal Transverse Mercatur, North American Datum of 1927, Clarke 1866 spheroid. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on this FIRM.

Figure J-6. CCO Meeting Dates for Pre-Countywide FISs Table

For this countywide FIS, Woodward-Clyde was contracted by FEMA to perform the coastal flood studies of the Florida Panhandle under Contract No. EMW-95-C-4678/TO043. The coastal 100-year stillwater elevations and analyses were revised by Dewberry & Davis, under subcontract to Woodward-Clyde. All work was completed in April 1998. Riverine analyses for this countywide FIS were compiled from previously effective FISs for Bay County and its incorporated communities (References 1 - 9).

The digital base map files were derived from U.S. Geological Survey (USGS) 1:24,000 scale Digital Line Graphs. These files were modified in and around the floodplains to match data previously compiled for the FIS of Bay County and its unincorporated communities.

The coordinate system used for the production of the digital FIRMs is Universal Transverse Mercator referenced to the North American Datum of 1927 and the Clarke 1866 spheroid.

1.3 Coordination

The purpose of an initial Consultation Coordination Officer's (CCO) meeting is to discuss the scope of the FIS. A final CCO meeting is held to review the results of the study.

The dates of the initial and final CCO meetings held for the incorporated communities within the boundaries of Bay County are shown in Table 1, "CCO Meeting Dates for Precountywide FISs."

TABLE 1 - CCO MEETING DATES FOR PRECOUNTYWIDE FISs

Community Name	Initial CCO Date	Final CCO Date
Bay County (Unincorporated Areas)	*	June 12, 1985
Callaway, City of	*	June 11, 1985
Cedar Grove, Town of	*	*
Lynn Haven, City of	*	June 11, 1985
Mexico Beach, Town of	*	June 12, 1985
Panama City, City of	*	June 12, 1985
Panama City Beach, City of	*	June 13, 1985
Parker, City of	*	June 6, 1985
Springfield, City of	*	May 17, 1979

*Data not available

Figure J-7. Streams Studied by Detailed Methods Table

TABLE 1 - STREAMS STUDIED BY DETAILED METHODS

Abrams Creek
Abrams Run
Baeder Run
Blair Mill Run
Blair Mill Run Tributary
Buckwalter Tributary
Colmar Tributary
Crow Creek
Davis Grove Tributary
Deep Creek
Dodsworth Run
Donny Brook Run
East Branch Perkiomen Creek
East Tributary Stony Creek
Erdenheim Run
Frog Run
Goshenhoppen Creek
Gulph Mills Creek
Gulph Mills Creek Tributary A
Gulph Mills Creek Tributary B
Hosensack Creek
Huntingdon Valley Creek
Indian Creek
Jenkintown Creek
Lansdale Tributary
Little Neshaminy Creek
Little Neshaminy Creek Tributary No. 1
Little Neshaminy Creek Tributary No. 2
Lodal Creek
Macoby Creek
Macoby Creek Branch
Manatawny Creek
Matsunk Creek
Meadow Brook
Middle Creek
Mill Creek
Mingo Creek
Mingo Creek Tributary No. 1
Minister Creek
Minister Creek Tributary
Neshaminy Creek Branch
North Branch Baeder Run
North Branch Zacharias Creek
North Hatfield Tributary
Oak Terrace Tributary
Oley Creek
Oreland Run
Park Creek
Pennypack Creek
Pennypack Creek Branch
Pennypack Creek Tributary No. 1
Perkiomen Creek
Pine Run
Plymouth Creek
Rapp Run
Rock Creek
Rose Valley Creek
Sanatoga Creek
Sandy Run
Sandy Run Tributary No. 1
Sawmill Run
Schlegel Run
Schuylkill River
Scioto Creek
Skippack Creek
Skippack Creek Tributary No. 1
Skippack Creek Tributary No. 2
Southampton Creek
Sprogels Run
St. Josephs Run
Stony Creek
Stony Creek Tributary
Stony Run
Swamp Creek
Tacony Creek
Tannery Run
Towamencin Creek No. 1
Towamencin Creek No. 2
Tributary to Oreland Run
Tributary No. 1 to Unionville Tributary
Trout Creek
Unami Creek
Unionville Tributary
Unnamed Creek A
Valley Creek
Vaughn Run
War Memorial Creek
West Branch Neshaminy Creek
West Branch Neshaminy Creek Tributary
West Branch Perkiomen Creek
West Branch Skippack Creek
West Branch Swamp Creek
West Branch Towamencin Creek
West Branch Towamencin Creek Tributary No. 3
Wissahickon Creek
Zacharias Creek

Figure J-8. Scope of Study Table

TABLE 3 - SCOPE OF STUDY

Stream	Limits of Detailed Study
Abrams Creek	From its confluence with the Schuylkill River to a point approximately 60 feet upstream of Brawnlee Road
Abrams Run	From its confluence with Crow Creek to a point approximately 420 feet upstream of Falcon Road
Crow Creek	From its confluence with the Schuylkill River to a point approximately 80 feet upstream of Croton Road
Frog Run	From Flint Hill Road to a point approximately 440 feet upstream of South Henderson Road
Gulph Mills Creek	From Holstein Road to a point approximately 330 feet upstream of Gypsy Road
Gulph Mills Creek Tributary A	From its confluence with Gulph Mills Creek to a point approximately 80 feet upstream of Arden Road
Gulph Mills Creek Tributary B	From its confluence with Gulph Mills Creek to a point approximately 65 feet upstream of Lantern Lane
Matsunk Creek	From its confluence with the Schuylkill River to a point approximately 620 feet upstream of Crooked Lane
Unnamed Creek A	From its confluence with Matsunk Creek to a point approximately 80 feet upstream of Flint Hill Road

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

This countywide FIS also incorporates the determination of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Special Response [SR], Letter of Map Amendment [LOMA]), as shown in Table 4, "Letters of Map Change."

TABLE 4 - LETTERS OF MAP CHANGE

Community	Flooding Source(s) and Project Identifier	Date Issued	Type
Borough of Collegeville	Donny Brook Run Updated hydrologic and hydraulic data for the Statford Avenue culvert	July 23, 1990	LOMR

Figure J-9. Stream Name Changes Table

Table 2, "Stream Name Changes," lists streams that have names in this countywide FIS other than those used in the previously printed FISs for the communities in which they are located.

TABLE 2 - STREAM NAME CHANGES

Community	Old Name	New Name
Township of Abington	Tributary No. 1	Sandy Run Tributary No. 1
Borough of Hatfield	Towamencin Creek	Towamencin Creek No. 2
Township of Hatfield	Tributary to Unionville Tributary	Tributary No. 1 to Unionville Tributary
Township of Horsham	Branch of Pennypack Creek	Pennypack Creek Branch
Borough of Lansdale	Branch of Neshaminy Creek	Neshaminy Creek Branch
Township of Limerick	Tributary No. 1 to Mingo Creek	Mingo Creek Tributary No. 1
Township of New Hanover	Tributary to Minister Creek	Minister Creek Tributary
Borough of Norristown	Tributary to Stony Creek	Stony Creek Tributary
Township of Skippack	Tributary 1 to Skippack Creek	Skippack Creek Tributary No. 1
Township of Towamencin	Towamencin Creek	Towamencin Creek No. 1
	Tributary No. 1 of Skippack Creek	Skippack Creek Tributary No. 2
	Tributary No. 3 of West Branch Towamencin Creek	West Branch Towamencin Creek Tributary No. 3
Township of Upper Merion	Abrams Run	Crow Creek
	Gulph Creek	Gulph Mills Creek
	Gulph Creek Branch	Gulph Mills Creek
Township of Upper Moreland	Tributary 1	Pennypack Creek Tributary No. 1

For the December 19, 1996, FIS, the Schuylkill River was restudied by detailed methods, including its backwater effects, for its entire length within the county.

For this revision, limits of detailed study for the newly studied streams are listed in Table 3, "Scope of Study."

Figure J-10. Historical Tide Gage Water Level Records Table

The coastal areas of Walton County are subject to flooding from tidal surges associated with hurricanes both along the Gulf of Mexico and inside Choctawhatchee Bay. Generally, the terrain inland along Choctawatchee Bay rises fairly rapidly and flooding from surges is restricted to only short distances inland of the bay shoreline.

Walton County has experienced flooding from several hurricanes since 1870. Reports of high water marks for the hurricanes of 1936 were 8.4 feet NGVD at Fort Walton Beach, Okaloosa County, and from 7 to 8 feet NGVD at Destin, in Okaloosa County. This compares with the GKY 100-year surge prediction of 2 to 7 feet NGVD. The prediction does not incorporate the effects of wind driven waves or the tidal influences of the heavenly bodies. In October 1995, Hurricane Opal produced high storm surge tides in Walton County. Hurricane Opal highwater marks along the Gulf of Mexico shoreline of Walton County were from 8 to 25 feet NGVD and in Choctawhatchee Bay from 6 to 7 feet NGVD. Present conclusions about recurrence coastal flood elevations rely heavily on historical evidence from the continuous tidal records identified in Table 1.

For this countywide FIS, in order to evaluate existing FIS coastal flood frequencies and revised 100-year stillwater elevations, historical tide gauge water level records for the Florida Panhandle region were used. These water level records are shown in Table 1.

TABLE 1 - HISTORICAL TIDE GAUGE WATER LEVEL RECORDS FOR FLORIDA PANHANDLE REGION

AGENCY and GAUGE I.D.	SITE NAME	LATITUDE	LONGITUDE	MEAN TIDE RANGE (FT)	PERIOD of RECORD
NOS 8728690	Apalachicola	29° 43.6' N	84° 58.9' W	1.11	1967-95
USACE 02359665	Panama City	30° 09'22" N	85° 38'12" W	1.33	1935-95
NOS 8729108	Panama City	30° 09.1' N	85° 40.0' W	1.24	1975-95
NOS 8729210	Panama City Beach	~ 30.2° N	~ 85.8° W	1.25	1989-94
USACE 02366990	Destin/East Pass	30° 23'20" N	86° 30'04" W	0.58	1957-94
NOS 8729681	Navarre Beach	30° 22.6' N	86° 51.9' W	0.74	1978-89
NOS 8729840	Pensacola	30° 24.2' N	87° 12.8' W	1.19	1923-95
USACE 02376083	Gulf Beach	30° 18'50" N	87° 25'40" W	0.83	1940-95

Brief notes on the history and damages caused by hurricanes are abstracted from reports by the U.S. Army Corps of Engineers (USACE) (References 6 and 7). Additional information on hurricane history and damages, particularly for recent storms, comes from papers published in the Monthly Weather Review. The following pages list the significant storms affecting the panhandle in this century. Damage figures are those determined for values at the time of the storm, and no attempt has been made to adjust these figures to present day values.

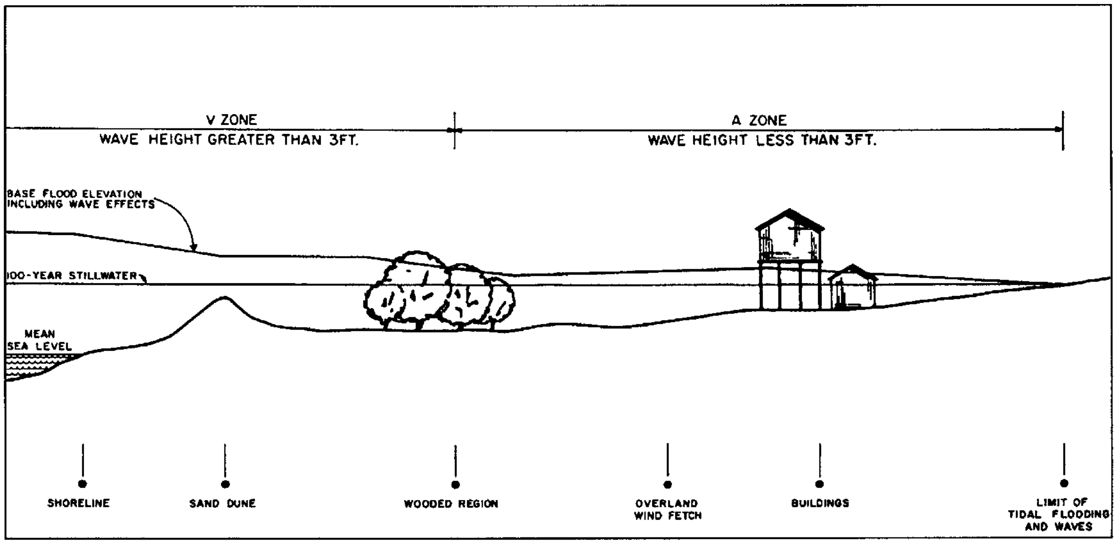
Figure J-11. Manning's "n" Values Table

The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 6, "Manning's "n" Values."

TABLE 6 - MANNING'S "N" VALUES

Stream	Channel "n"	Overbank "n"
Abrams Creek	0.035-0.040	0.030-0.070
Abrams Run	0.013-0.035	0.035-0.050
Baeder Run	0.018-0.070	0.040-0.110
Blair Mill Run	0.032	0.060-0.087
Blair Mill Run Tributary	0.035-0.037	0.080-0.095
Buckwalter Tributary	0.040-0.045	0.050-0.120
Colmar Tributary	0.025-0.035	0.070
Crow Creek	0.035	0.030-0.050
Davis Grove Tributary	0.040-0.050	0.050-0.130
Deep Creek	0.035-0.045	0.050-0.080
Dodsworth Run	0.012-0.032	0.050
Donny Brook Run	0.012-0.050	0.030-0.125
East Branch Perkiomen Creek	0.013-0.090	0.033-0.125
East Tributary Stony Creek	0.045-0.050	0.055-0.085
Frog Run	0.035-0.040	0.020-0.050
Goshenhoppen Creek	0.035-0.040	0.060-0.080
Gulph Mills Creek	0.035-0.040	0.040-0.050
Gulph Mills Creek Tributary A	0.035	0.050
Gulph Mills Creek Tributary B	0.040	0.050
Hosensack Creek	0.035-0.040	0.035-0.080
Huntington Valley Creek	0.030-0.035	0.070-0.085
Indian Creek	0.030-0.040	0.050-0.125
Jenkintown Creek	0.050	0.130
Lansdale Tributary	0.020-0.035	0.060-0.075
Little Neshaminy Creek	0.030-0.050	0.050-0.110
Little Neshaminy Creek Tributary No. 1	0.045-0.060	0.075-0.120
Little Neshaminy Creek Tributary No. 2	0.025-0.050	0.060-0.120
Lodal Creek	0.040	0.055-0.080
Macoby Creek	0.030-0.045	0.030-0.090
Macoby Creek Branch	0.040	0.050-0.080
Manatawny Creek	0.035-0.040	0.050-0.090
Matsunk Creek	0.035-0.040	0.020-0.050
Meadow Brook	0.030-0.035	0.055-0.080
Middle Creek	0.032-0.055	0.030-0.120
Mill Creek	0.020-0.043	0.015-0.090
Mingo Creek	0.040	0.055-0.080
Mingo Creek Tributary No. 1	0.035-0.040	0.050-0.060

Figure J-12. Transect Schematic



TRANSECT SCHEMATIC Figure 3

TABLE 5 – TRANSECT DESCRIPTIONS

TRANSECT	LOCATION	ELEVATION (feet NGVD) 100-YEAR STILLWATER	MAXIMUM 100-YEAR WAVE CREST
1	At shoreline of Gulf of Mexico, in the unincorporated areas of Walton County, approximately 2.4 miles east of the Okaloosa/Walton County line.	10.5[1]	16.1
2	At shoreline of Gulf of Mexico, in the unincorporated areas of Walton County, south of Morris Lake.	10.5[1]	16.1
4	At shoreline of Gulf of Mexico, in the unincorporated areas of Walton County, approximately 1,200 feet southeast of intersection of County Route 30-A and Blue Mountain Road.	15[1]	16.1

[1]Includes wave setup of 2.5 feet.

Figure J-13. Community Map History Table

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Abington, Township of	March 2, 1973 May 28, 1976	None	September 30, 1977	January 2, 1991 March 3, 1992 December 19, 1996
Ambler, Borough of	May 31, 1974	April 30, 1976	November 2, 1977	August 18, 1992 December 19, 1996
Bridgeport, Borough of	January 16, 1974	December 13, 1976	January 3, 1979	December 19, 1996
Bryn Athyn, Borough of	December 20, 1974	None	February 17, 1982	May 15, 1991 December 19, 1996
Cheltenham, Township of	June 28, 1974	April 11, 1975	November 22, 1976	December 19, 1996
Collegeville, Borough of	November 22, 1974	None	February 15, 1980	December 19, 1996
Conshohocken, Borough of	March 22, 1974	None	December 15, 1977	December 19, 1996
Douglass, Township of	November 1, 1974	None	May 15, 1984	July 2, 1991 December 19, 1996
East Greenville, Borough of	November 15, 1974	None	July 25, 1976	December 19, 1996
East Norriton, Township of	June 28, 1974 July 9, 1976	None	September 30, 1977	December 19, 1996

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MONTGOMERY COUNTY, PA
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY